Chapter 3
Development of a Conceptual Site Model for OE Projects

3-1. Introduction

This chapter describes the CSM development process for sites with OE, defines key terms, and provides examples specific to these sites for each step of the development process. Some military lands containing OE have been transferred to other government agencies and civilian ownership, and out of military control. Current and reasonably anticipated future land use may not be compatible with the hazard posed by OE at these sites. The primary focus of the OE CSM is to illustrate the interaction between OE sources and receptors. Interaction between the receptor and an OE source has two components: access and activity. The CSM is developed through collection of the profile information (see Paragraph 2-4) and subsequent pathway analysis.

OE consists of either (1) ammunition, ammunition components, chemical or biological warfare material or explosives that have been abandoned, expelled from demolition pits or burning pads, lost, discarded, buried, or fired (e.g., UXO) and that are no longer under accountable record control of any Department of Defense organization or activity or (2) explosive soil, where any mixture of explosives in soil, sand, clay, or other solid media is at such concentrations that the mixture itself is explosive.

3-2. Profile Information Resources

The initial step in OE CSM development is to collect profile information for the site. For most sites, an Archives Search Report (ASR) or similar document provides useful profile information. However, the ASR alone should not be viewed as presenting a comprehensive understanding of site conditions. Additional records searches, a site visit, and personnel interviews are other recommended resources. Local officials with the fire or law enforcement offices would typically have information if there have been responses to OE discoveries. Historical ground and aerial photographs may be obtained from installation or military archives. In addition, a detailed military photogrammetric analysis should be conducted if this has not already been done.

An **Archives Search Report** is an evaluation of past OE activities at an installation. The purpose of an ASR is to assemble historical records and available data and assess potential ordnance presence.

3-3. Facility Profiles

Facility Profiles for OE sites are focused on identification of OE source areas. An OE source area is the location where ordnance or explosives are expected to be found based on available information. The OE may be present as a result of direct military activities or placed there at some later time.

a. OE source areas include grenade courts/ranges, air-to-ground gunnery ranges, maneuver areas, etc. Table 3-1 lists OE area types, the possible activities that took place there, and the potential OE items for each area.

Table 3-1. Common OE Area Types, Activities, and Potential OE

OE Area Type	Possible Activity	Potential OE[1]
Small Arms	Pistol, rifle, machine gun and skeet firing ranges	Small arms ammo .50 caliber and less
Grenade	Hand grenade range Rifle grenade range	Hand or rifle grenades
Artillery	Anti-aircraft, tank, recoilless rifle ranges	Projectiles and submunitions
Bombing	Aircraft bombing	Bombs and submunitions
Air-to-Air	Air-to-air firing	Small arms rounds, projectiles, rockets, and guided missiles
Air-to-Ground	Strafing and other air to ground firing	Small arms rounds, projectiles, rockets, and guided missiles
Ground-to-Air	Anti-aircraft firing	Small arms rounds, projectiles, rockets, and guided missiles
Ground-to-Ground	Rocket and missile firing	Rockets and guided missiles
Multiple/Combined Use	Multiple training activities	Small arms rounds, projectiles, grenades, rockets and bombs
Training/Maneuver Areas	Tactical training	Small arms rounds, signals, booby traps, trip flares and other pyrotechnics, and other training devices
OB/OD Areas	Disposal of munitions	Various OE items surplus to operations
Ammunition Plants	Production of explosives and munitions	High explosives, explosive soils, process residuals
Storage Areas/Transfer Points	Storage and handling of munitions	Various munitions and explosives in approved storage configuration
Firing Points	Preparation and firing of authorized weapons systems	Unfired or abandoned munitions and explosives
Burial Pits	Mass burial of large quantities of OE	Unfired or abandoned munitions and explosives
Bivouac Areas	Troop encampments	Probably few or no OE items

[1]Potential for both live and inert munitions types listed. Inert items are considered OE scrap.

b. Source areas at OE sites may be determined from indicators common to many OE areas. Some of these indicators are as follows:

- Scarring of land.
- OE scrap present.

- Historical records of OE use.
- Land features indicating OE related use.
- Vegetation features indicating OE related use.
- OE found.
- Eyewitness accounts of OE use.

These indicators can help the team focus on areas where the probability of OE is greatest; however, absence of the indicators may not indicate lack of OE. Figures 3-1 and 3-2 are photographic examples of some OE indicators.

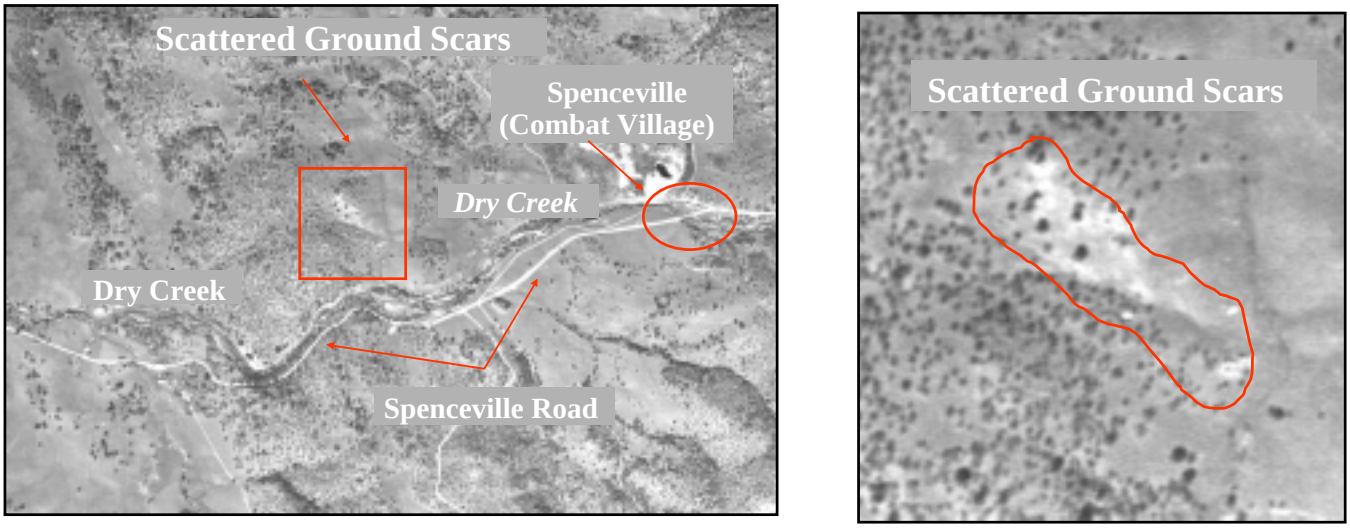

Figure 3-1. Ground Scars Indicating Potential OE Use

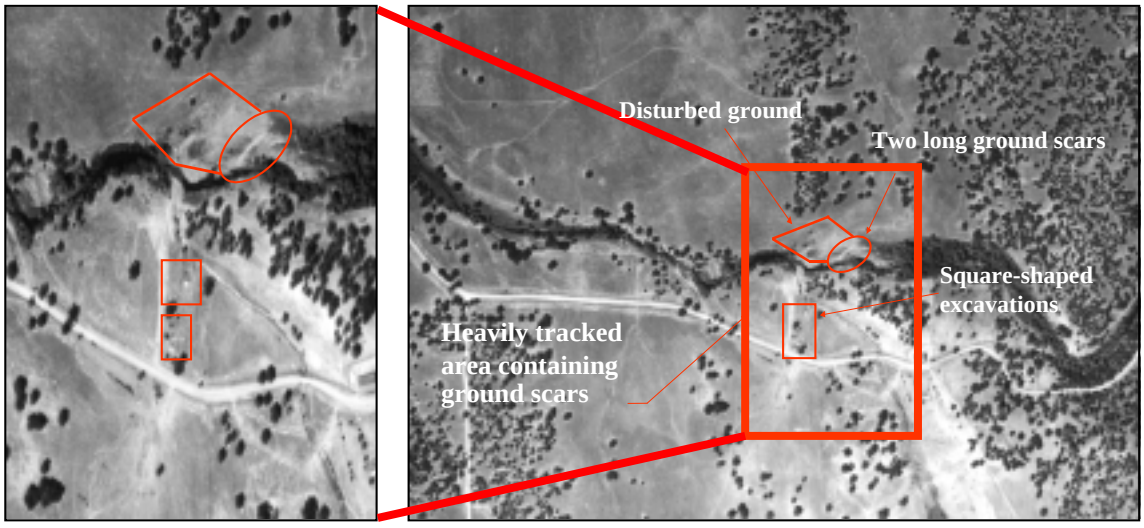

Figure 3-2. Tracked Areas and Ground Scars Indicating Past Range Activities

c. Military use of a site may change over time. The same range may be used for several different activities and therefore contain a variety of OE items. Range dimensions and orientations may change as a result of target relocation (Figure 3-3). The team must consider the potential for changing use at each OE site.

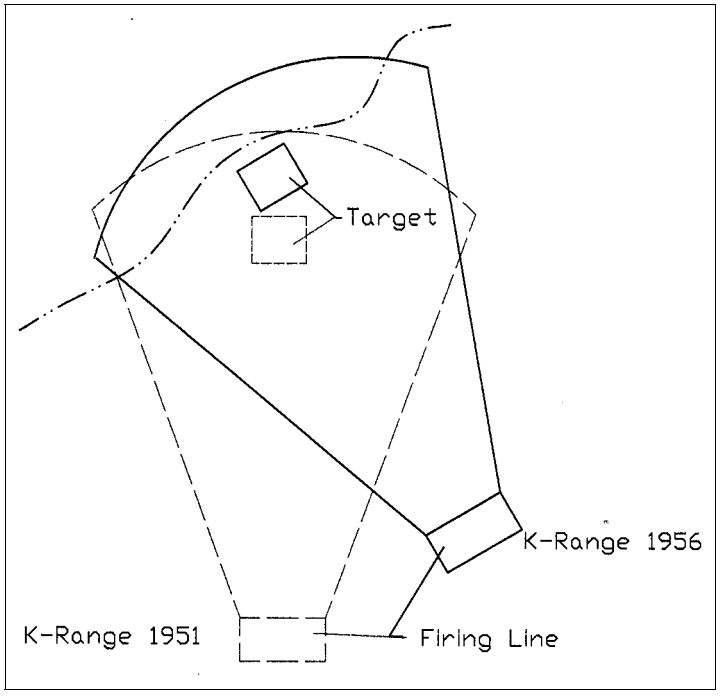

Figure 3-3. Range Orientation over Time

3-4. Physical Profiles

Physical properties of a site that affect the location, movement, detection, and recovery of OE are described in the Physical Profile for a site.

a. Location of OE. Location refers to both the areal (horizontal) extent as well as the vertical extent (depth) of OE.

(1) *Areal Extent of OE*. This is related to the distribution of OE items from the use that occurred at that site. Usually, the type or limits of fire of a weapon system or a munition will provide a basis for areal distribution of the OE. Standard layouts for range boundaries may be used to help determine the probable location of OE. Terrain features are important when assessing the dimensions or potential hazards of some ranges, as these can limit the areal extent of OE. Natural or man-made barriers will produce a "shadow effect" on the distribution of ordnance fired at a target with a terrain feature as a backstop. An illustration of this is provided in Figure

3-4. The standard layout for a range is shown in both design and as-built drawings for a former military installation. As shown on the as-built, the total area of the range is reduced by the terrain feature. Note this effect is more applicable to direct fire weapons (e.g., bazooka) rather that indirect fire systems such as mortar or artillery.

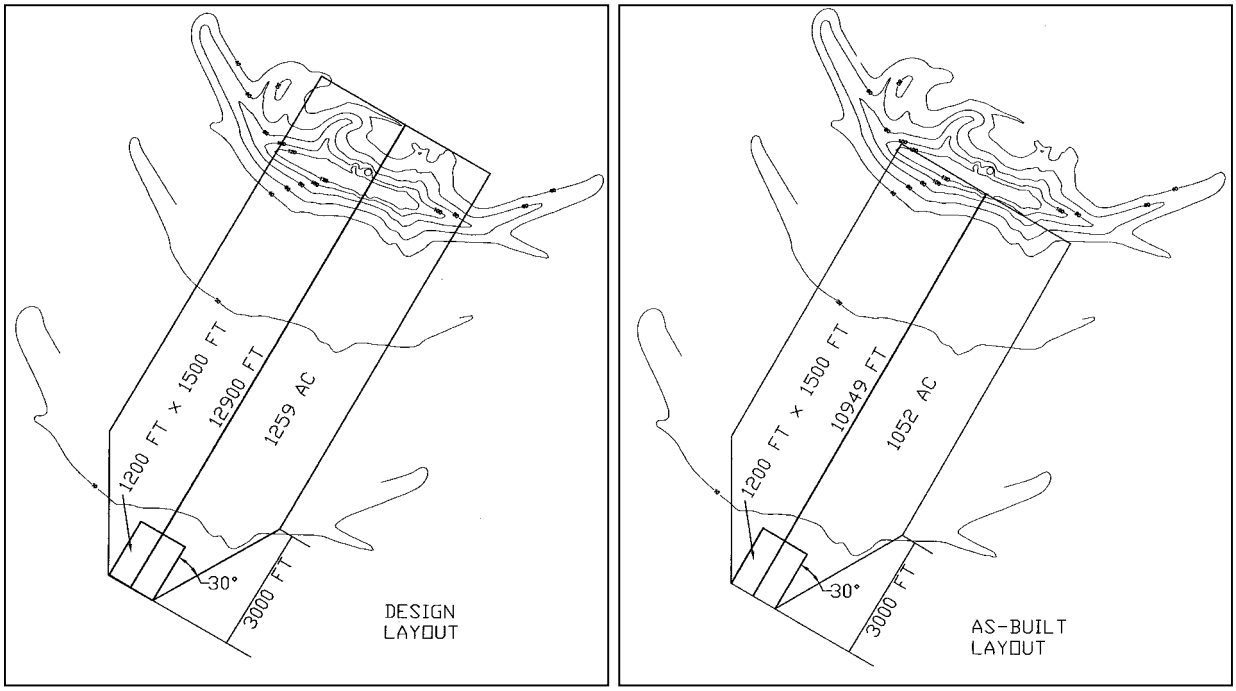

Figure 3-4. Terrain Effects on Range Dimensions

(2) *Vertical Extent of OE*. Subsurface conditions can affect the vertical extent of OE. For instance, soil type, soil moisture, and vegetation are important physical factors in determining the penetration depth of certain ordnance. The team should attempt to determine the probable depth of penetration by the ordnance. This information is important to determining both the safety hazard from OE and the cost of detection or cleanup. Site-specific information includes soil type, soil moisture, topography, and vegetation. Weapons system information includes ordnance geometry and weight, striking velocity, and angle of entry. Even with this information, investigators should be aware that there may exist dramatic differences in penetration depth from the same ordnance. For example, loose, sandy soil will typically allow less penetration of similar ordnance than will dense clay. The depth or location of OE is an important factor when developing clearance objectives for future land use.

b. *Movement of OE*. The team must evaluate physical processes that may affect movement of OE items. Erosion, scouring, or flooding of surrounding soil or sediment, frost heave, or tidal currents are natural processes that can cause movement of ordnance items from their original depth or location. The geology, geomorphology, and hydrology of the OE source area should be collected to assess this potential.

c. Detection of OE. Many naturally occurring site conditions affect the detection of subsurface OE. Physical characteristics affect specific detection instruments in different ways. Terrain and geology features may introduce electronic noise into the process, making detection difficult. Dense vegetation may affect the ability to get an instrument's sensor close enough to the surface, thereby limiting its effectiveness. Terrain, vegetation, and soil composition are key data elements to be collected. These data will be used in the selection of appropriate geophysical instruments and methods.

d. Recovery of OE. Certain physical features affect the ability to access and recover OE at a site, and this information should be collected. These features can include excessive relief, rough terrain, wetlands and water bodies, and difficult vegetation.

3-5. Release Profiles

Release mechanisms include those physical processes that contribute to the relocation of OE in the environment, after initial placement. An OE item tends to lie in place unless disturbed by either a natural process, as noted previously, or human activity. Construction, excavation, plowing or tilling, and surface soil or vegetation removal are examples of human activities that may relocate OE. Ordnance that was once deeply buried may become more accessible by removing overlying material. Any possibility of release of chemical constituents from OE items should be identified, considered as a source in an HTRW CSM, and addressed in an integrated CSM.

3-6. Land Use and Exposure Profiles

The Land Use and Exposure Profiles are used to identify on-site and surrounding off-site land use and associated receptors. The Land Use Profile must identify the means of access or potential activities. The Exposure Profile identifies the available receptors at and near a site, and the activities whereby they may contact OE. Demographic information should also be included. This process will also be performed for any reasonably anticipated future land use. These profiles will assist in determination of the appropriate receptors to be evaluated in the pathway analysis.

3-7. Ecological Profiles

The on-site or surrounding property should be described and its primary use documented. OE projects typically consider humans as the primary and often the only receptor to OE, because ecological receptors typically do not engage in activities that expose them to OE hazards. However, site activities in support of OE projects, particularly vegetation removal and detonation of recovered OE, may significantly affect ecological receptors and should be evaluated.

3-8. Pathway Analysis

Careful analysis of the profile information should allow the team to identify all source–receptor interactions for an OE project. The CSM will illustrate all potential exposure pathways (see Paragraph 2-6 for various CSM representations). For OE, an exposure pathway must include a **source**, **access**, **activity**, and a **receptor**. Interim measures, including access controls, source removals, or isolation methods, may interrupt the exposure pathway and should be considered in the analysis.

a. Sources. An OE source area is the location where ordnance or explosives are expected to be found, based on available information. The OE may be present as a result of direct military activities or placed there at some later time. Source areas were identified during generation of the Facility, Physical, and Release Profiles from available documentation or from direct evidence compiled during a site visit, or both. OE source areas are described by the following three components: the number and type of OE areas, the location and dimensions of each area, and the type and distribution (including depth) of OE within each area. Some processes such as frost heaving or erosion may change the location or distribution of OE items. This movement can increase the potential for direct contact.

b. Interaction. Information from all profiles will assist in identifying source–receptor interactions. Interaction is the means by which receptors come in contact with OE. This interaction requires two closely connected elements: access and activity. Access is the ability of a receptor to enter the source area. Activity is any action by a receptor that may result in direct contact with individual OE items.

Interaction between the receptor and an OE source has two components: access and activity. **Access** is the ability of a receptor to enter a source area. **Activity** is any action by a receptor that may result in direct contact with individual OE items in the source area.

(1) *Access.* The presence of access controls will help determine whether an exposure pathway to a receptor is complete, as fences or natural barriers can limit human access to a source area. The depth of OE items in subsurface soils may also limit access by a receptor. Additionally, the team must consider the effect that future land use can have on site access. Access may be unlimited for explosive ordnance disposal (EOD) personnel or construction workers, but may be restricted for nearby residents or other potential receptors. Ease of entry for adjacent populations (e.g., lack of fencing) can facilitate trespassing at the site, either intentional or accidental.

Access and Activity at an OE Site

(2) *Activity*. The hazard presented by OE is caused by direct contact as a result of some human activity. Site access without such activity does not present a hazard. Identification of OE exposure pathways should focus on current or future activities that bring humans into contact with the OE. Future use of OE land may result in intrusive activities (e.g., construction or agriculture) that also increase the potential for contact.

c. Receptors. The receptors evaluated in the OE CSM were identified in the Land Use and Exposure Profile. Both current and future receptors must be considered for OE sites, and access controls are critical to this determination. Human receptors are categorized by their ability to access the site combined with the activities that potentially allow contact with OE. Construction workers, ranchers, EOD personnel, recreational users, trespassers, and residents are examples of potential receptors.